UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF BIOLOGICAL SURVEY

FACTS ABOUT SNAKES

INTRODUCTION

Few native animals are more imperfectly known, more persecuted, and more misrepresented than snakes. Contrary to popular belief most of them are neither obnoxious nor poisonous. Because of false teaching many persons have a great dread of snakes and there are very few who care to have these reptiles around their homes. Campers are often troubled with snakes which take refuge under bedding, boxes, or clothing. Nervous people suffer severe shocks from discovering snakes in unexpected places. Constant worry for fear that there will be a repetition of this unpleasant experience can be avoided by taking necessary precautions. In most cases snakes can be prevented from entering places where they are not wanted.

It must be remembered that there are many kinds of snakes and that their habits are nearly as varied as those of birds and mammals. Some snakes burrow in the ground and are rarely seen; others are gliders and move very swiftly; some are swimmers and spend most of their lives in swamps, ponds, or streams; and a few climb trees. There are certain kinds of snakes which are found only in desert regions, others in marshes, and many that live in the fields and woods around our homes.

Most snakes are "gliders." Large transverse scales or shields are present along the entire length of the body on the ventral surface. There are as many scales as pairs of ribs. In gliding, a snake advances the fore part of its body; the ventral transverse scales on this part of the body are then partially erected, the weight of this part of the body thrown on these erected transverse scales, and a rather firm hold secured on the surface; the rest of the body is then drawn forward by the contraction of muscles. This process is repeated very rapidly and as the ribs are active agents in this peculiar method of propulsion, snakes are sometimes referred to as "rib-walkers." Snakes that climb are more agile than terrestrial species. Some snakes wind their bodies around the tree when climbing; others, like black-snakes, can climb rough-barked trees by progressing in wide sinuous curves. In swimming a snake depends as much upon undulating movements of the body as upon short strokes of the tail.

SUGGESTIONS FOR THE ERADICATION OF SNAKES

So far as known, only one method of eradication is successful and that is to kill the snakes by clubbing or shooting. There are so many snakes in most neighborhoods and they frequent such inacessible spots that total eradication is practically impossible. So long as there are large uninhabited areas, snakes will continue to spread into settled districts, even though a constant warfare be kept up against them. The introduction of predatory animals, like the mongoose, to combat them, no matter which sex, is never desirable because they destroy at least as many ground-nesting

birds as they do injurious animals. Local campaigns for the destruction of poisonous snakes, such as the cottonmouth moccasin, the copperhead, the rattlesnake, the massasauga, and the coral snake are desirable in many districts. Most of the non-poisonous snakes are distinctly beneficial in that their food consists to a large extent of injurious rodents and insects and campaigns against snakes should discriminate between poisonous and non-poisonous varieties.

In spring whole colonies of rattlesnakes and copperheads can often be destroyed by locating the rocky ledge beneath which they have wintered. Here in the early days of March and April they lie in the sun and are so sluggish that they may easily be despatched with clubs. Later on in the spring they spread out to the fields and the hillsides in search of mice, small birds, and other prey. Where conditions permit, numbers of hogs, if given free run of snake infested areas, will greatly reduce the snake population.

Except to this method control measures can not be applied against snakes on a large scale and each reptile has to be considered individually. A few snakes, like the blacksnake (Coluber constrictor) and chicken snakes (Elaphe quadrivittata and Elaphe bairdi), enter poultry houses and barns in search of eggs or young birds. Snakes which are known to feed on eggs may sometimes be killed by poisoned eggs. The most satisfactory method of preparing the bait is to make a small hole in a fresh egg, and to introduce through it 2 or 3 medium-sized crystals of strychnine. A piece of paper should then be pasted over the hole and allowed to dry. To prevent leaking when the poisoned egg is put out for the snake, care should be taken to see that the part of the egg with the hole in it is placed highest. This remedy will prove effective only in case a snake has formed a habit of raiding hen's nests. Poisoned eggs placed at random might never be taken and within a few days they would become unattractive as bait. The promiscuous distribution of poisoned eggs would be very dangerous also as it might cause the death of a number of domesticated animals, especially hogs. Blacksnakes and chicken snakes are not very wary and appear incapable of detecting "doctored eggs." Most of our snakes feed chiefly on living prey, and thus can not be destroyed by the use of poisoned baits.

No successful apparatus for snaring snakes has ever been devised. It is difficult to induce a snake to enter a trap, for it has no fixed trails and lacks inquisitiveness. Some collectors have been able to capture certain kinds of snakes by tying a small frog by one leg to a stake in suitable surroundings. The snake swallows the frog and is held captive until digestion dissolves the swallowed bait giving the trapper opportunity to return and dispose of the snake. Another method is to dig pits some three or more feet deep with vertical sides and place several live frogs or mice in them for decoys. Such pits should not be used in any neighborhood where either live stock or humans are accustomed to travel. Professional collectors depend almost entirely upon a forked stick or a pair of iron tongs, 3 or 4 feet in length, to capture snakes.

REPELLENTS

Traditions handed down by the Indians and superstitions traceable to the negro slaves during the early settlement of this country have credited certain ornamental plants with remarkable attributes as snake repellents. The odor or emanations from the tree and from its dead leaves on the ground have been held to make the mountain ash tree (Sorbus americana) obnoxious to snakes. In the southern States, colored people for generations have planted the snake calabash (Lagenaria vulgaris) and the snake gourd (Trichosanthes anguina) and trained the vines to grow over their houses and along their garden fences in the belief that the odor of these gourd vines will repel snakes. The pungent fishy odor given off by full-grown leaves of the horseshoe geranium (Pelargonium zonale) are also thought by some to drive away snakes. Various other plants also are supposed to possess similar powers, but careful investigation has failed thus far to corroborate any potency of this sort on the part of any plants. So far as known, there are no plants growing in North America which will drive away snakes or which will cause snakes to avoid areas on which they are growing. None of the various repellents, such as cayenne pepper, fresh slaked lime, or powdered sulfur, which have been suggested from time to time, have been found to possess any particular merit.

In many parts of the West the old-time horse or cow-hair ropes, about 30 feet long, were and still are used by cowboys, ranchers, and prospectors, to surround their beds when sleeping on the ground, in the belief that they would exclude snakes. Experimentation with live rattlesnakes as well as with harmless snakes has shown that no protection is afforded by a hair rope. Repeated trials have proved that a rattlesnake will crawl over a hair rope without any hesitation.

POISONOUS GASES

Snakes appear to be immune to the effects of certain kinds of poison gases, such as phosgene, chlorine, and tear chemicals. Tests conducted in a cave near San Marcos in Hays County, Texas, approximately 50 miles north of San Antonio, failed to produce any results when phosgene and chlorine fumes were forced under pressure into the recesses of a rocky cave infested with rattlesnakes. On the other hand, when mustard gas was forced into the crevices of a bed of lava rock in the State of Washington rattlesnakes were driven out in a dazed and blinded condition and were easily killed with clubs.

PRECAUTIONARY MEASURES

Campers should avoid pitching their tents in the vicinity of rocky ledges. Clean camping sites are preferable and swampy areas should be avoided. Everyone should take the necessary precautions of observing where they walk and especially where they put their hands. Bedding and clothing should be hung up during the day. There is very little likelihood of any accidents if one bears the above suggestions in mind. Hunters in southern States have found that leather leggings afford sufficient protection against the bites of poisonous snakes, and a specially constructed rubber boot, with a shank including several layers of canvas, sold to quail hunters in

Florida is a perfect protection for the parts it covers.

Full information about poisonous snakes and methods of treating their bites are contained in Information Leaflet Bi-571, Poisonous Snakes of the United States.

SUGGESTIONS FOR SNAKE-PROOFING A BUILDING

Snakes sometimes prove troublesome by entering houses or buildings used for workshops and storage. If the buildings are constructed so that they can be tightly closed or sealed up for a short period, the use of hydrocyanic acid gas is recommended. Full instructions for using this gas are contained in Farmers' Bulletin 699, which may be obtained on application to the Division of Publications, United States Department of Agriculture. If this gas is used the building will have to be vacated for a day or more, for it is extremely deadly and will destroy every living thing within the building.

When snakes gain access to a building, the doors and windows of which are screened, there must be crevices in the walls, foundation, or floor. In such cases all openings in the floor, weather-boarding, sills, foundations, and around fireplaces and chimneys should be carefully closed up. If a building can be surrounded by a fairly deep vertical-sided trench with no bridges over it, snakes will be excluded, but in ordinary soils such a trench will not long retain its effectiveness. A more permanent concrete moat would in most cases probably be considered too expensive.

The construction of tight basement walls or sealing the sides of a cellar with a layer of cement will exclude snakes. Foundations under houses and barns may be "pointed-up" with cement in the same way. If the walls under any building are sealed with cement and all low windows screened, snakes and other undesirable animals can not gain entrance. Debris which often accumulates under porches should be removed and the space kept clean.

SNAKE MYTHS

Since the earliest periods of time reptiles, particularly snakes, have been endowed by man with all sorts of mythical attributes and peculiarities; these beliefs are still held by a surprisingly large number of persons. The fairy tales of childhood become more vague with the passing of years, but it is no easy task to convince people that tales told about snakes are merely delusions. The superstitious fear of snakes in general has become so firmly fixed in our minds that it is almost impossible to eradicate the feeling. Those who attempt to dispel stories about snakes sucking cows, stinging snakes armed with an extraordinary spike-like tail, or those dealing with hoop snakes which take their tails in their mouths and roll in pursuit of a victim with incredible velocity are looked upon either as contemptible scoffers, or else grave doubts are entertained as to their mental condition.

Two of the most persistent and widespread snake myths in the United States deal with reptiles locally known as the "stinging snake" and the "hoop snake." Tales have long been told by negroes in the South of snakes

that form themselves into hoops and roll in pursuit of their victims with race-horse speed, the tails of which are furnished with horns. If the victim dodged and a tree was struck by the hoop snake it was sure to die. That any snake could place its tail in its mouth and roll along like a hoop is manifestly absurd, and taking into consideration the anatomical peculiarities of the vertebral column it is clearly impossible. The "stinging snake" myth apparently originated more than 200 years ago and is reported to have been first published in an old "Report to the Lords Proprietors of the Carolinas." John Clayton also mentions this myth in a letter to the Royal Society of London in 1688. In the first-mentioned report it is asserted that there lived in the Carolinas a snake whose tail was a poisoned horn or spike. This account refers to the horn or stinging snake (Farancia abacura), which is harmless. The horn snake is bluish-black with a few red bars across the belly. The tail of this snake tapers to a fine point having the appearance of a horn or spike, but it is quite incapable of piercing or stinging anything.

Another superstition exists with regard to the glass or jointed snake which is really a legless lizard. It is often said that a stroke of a stick will cause the body of this reptile to disjoint, the pieces wriggling off in every direction, and coming together again if the head part is not captured or destroyed. According to one version of this story there is one particular section which is endowed with the power to control the movements of the other joints and if this be destroyed, the reptile is deprived of its power to reassemble again. The explanation of this curious phenomenon lies in the ability of this reptile to drop its tail, an act which sometimes enables it to escape while the still-wriggling tail attracts the attention of the pursuer. Many other lizards do the same thing, and a "spike" or short and imperfect tail grows in the place of the lost tail. This curious reptile is rarely seen, as it lives under decaying vegetation and leaves or burrows in the soil. It is sometimes turned up by the plow. It has long been the subject of discussion, and is merely a harmless, legless lizard (Ophisaurus ventralis), and because of its food habits is of considerable value to agriculture.

Anyone who has ever milked a cow, knows that the amount of suction required to obtain a flow of milk is much greater than could be exerted by any snake. Furthermore, a snake has two rows of sharp recurved teeth in each upper jaw. If the mouth of the "milk snake" was closed to permit suction, the teeth would sink into the teat and the snake would find itself fully occupied in efforts to avoid injury by the cow.

The spreading viper or puffing adder (Heterodon contortrix), also known in certain sections as the blowing adder, hissing viper, and sand snake, is one of the greatest bluffers among snakes. Most of the names which have been given to this snake refer to its habit of spreading its head and neck when angered and hissing in a threatening manner. These actions have given rise to various superstitions, one of which is that its breath will kill a person as far as 20 feet away. This snake is entirely harmless. It is not poisonous and the teeth are too short to inflict a wound in case the snake did strike at a person. One of the peculiar habits of this snake is that of feigning death, which it accomplished by rolling over on its back. When turned over it immediately resumes this absurd position.

The coach-whip snake (Coluber flagellum) of the South is the object of a curious superstition which prevails among the negroes and which is held even by many of the whites. This snake has long been a terror to the colored population of the South, and many are the stories which relate to negroes being found dead in the road from being whipped to death by a coach-whip snake. These stories no doubt had their origin in warnings given years ago to restrain the negro slaves from straying off at night. The snake's habit of raising the fore part of the body when traveling confirmed, as far as the negro was concerned, the stories which had been told him about these snakes. The coach-whip snake is a slender, swift-moving, brownish-black snake of the southern and southwestern parts of the United States, and is entirely harmless to man.

HIBERNATION

All snakes in temperate climates hibernate during the colder months of the year. Their chance of survival in northern latitudes depends upon their burrowing ability. Those that burrow beneath the frost line survive the cold season; the others perish. Snakes are extremely sensitive to cold, many of our common North American snakes not ranging much farther north than the Canadian border, and others staying south of the Ohio River. The range of the garter snake is known to extend northward to the region around Great Slave Lake and there are records from the Yukon Region which appear to be authentic. This snake has an exceptionally wide range. In relatively mild climates blacksnakes have been found hibernating in cavities in trees several feet from the ground. Rattlesnakes, copperheads, and certain other snakes have dens in rocks in which they hibernate during the coldest part of the winter. At times large numbers of snakes congregate in a single cavity where they pass the winter. References are foundin literature to "bundles" of snakes found by workmen blasting in regions underlaid by a rock formation.

Except certain species adapted to extremes in aridity snakes, especially the subaquatic types, succumb also to intense heat. It has been reported that even the rattlesnakes which frequent the Mohave Desert, can be killed by 20 minutes' exposure to the direct rays of the mid-day sun. A number of our snakes aestivate, or become torpid, during the hottest part of summer.

SHEDDING SKIN

All vertebrates slough off their epidermis from time to time. In humans the change is gradual and imperceptible; other mammals like rabbits, mice, and squirrels change their hair in the spring and autumn; the "molt" of birds is well known. In the case of snakes, the entire epidermis including that covering the cornea of the eye is sloughed off entire. The process of sloughing starts at the jaws and the snake gradually crawls out of the slough. The length of time between successive sloughs varies. In captivity, some snakes shed about every month even during the coldest part of the winter. The frequency of sloughing varies with different individuals and possibly in the same individual at different ages. Prof. Samuel Garman stated that a large kingsnake in his possession shed its skin in April, July, and December, while its mate sloughed off its skin in March, May, August, and October. These snakes were kept in a warm room throughout the year. Ordinarily, about two sloughs are cast in a season; one on coming out

of hibernation in the spring, and another about mid-summer or later. A young and growing snake, however, sheds its skin more frequently. The milky appearance of the eyes of a snake shortly before the slough is cast is due to the separation of the outer layer of epidermis from the cornea resulting in impaired vision. This gives rise to various superstitions regarding snakes going blind during the "dog-days" of late summer.

ECONOMIC VALUE OF SNAKES

Most of our common snakes are very beneficial and should be protected in every way possible. Such snakes are not poisonous and while they may bite or attempt to when captured, their bite is nonvenemous. Snakes devour large numbers of insects and mice, many of which are injurious to garden crops and stored foodstuffs. One of the most abundant snakes in many parts of this country is the common garter or ribbon snake (Thamnophis). The natural food of these snakes consists of salamanders, small frogs, earthworms, insects, spiders, and an occasional mouse. When grasshoppers are plentiful they often subsist largely on them. The blacksnake (Coluber obsoletus), and the pine snake (Pituophis melanoleucus) subsist largely on field and meadow mice, chipmunks, rats, and young rabbits, and to a less extent on birds, frogs, and insects. The house snake or checkered adder (Lampropeltis triangulum) lives in the gardens and fields and, although entirely harmless, there seems to be much superstitious fear of it. The name "house snake" has been given it because it enters dwellings in the fall. More than half the yearly food of this snake consists of mice. It has been known also to eat other snakes. The kingsnakes (Lampropeltis getulus) are able to kill rattlesnakes and have been known to eat them. When the early settlers found these snakes fairly common throughout the region infested by rattlesnakes and moccasins, stories soon arose of their hunts for rattlers. The kingsnake does eat other snakes, but it does not deliberately hunt for poisonous snakes. The little red-bellied snake (Storeria occipito maculata) subsists to a large extent on slugs, pests very destructive to garden crops. The DeKay snake or rock snake (Storeria dekayi) has similar habits and eats slugs, snails, earthworms, and insect larvae. Insects constitute the main source of food for the smooth-scaled green snake (Liopeltis vernalis)and the rough-scaled green snake (Opheodrys aestivus),but snails and spiders form about one-fourth of the total bulk. The pretty little ring-necked snake (Diadophis punctatus) feeds mainly on insects and to a less extent on salamanders, small frogs, and earthworms. The rubber boa or ball snake (Charina bottae) will eat mice and small birds. Bull snakes and gopher snakes (Pituophis) destroy large numbers of injurious rodents in the course of a year. Even rattlesnakes do some good because ground squirrels, young prairie dogs, and other rodents are their main food.

The food habits of a few of our snakes are of a nature that they conflict with man's interests. The common water snake (Natrix sipedon) feeds largely on small fish, but in most cases their food has been found on examination to consist mainly of fishes not used as food by man, and the remainder of their food includes toads, frogs, salamanders, insects, and small mammals. The moon snake or queen snake (Natrix septemvittata) is known to feed largely on crayfish and toads. The blacksnake and the coach-whip snake destroy a certain number of ground-nesting birds, particularly young

quail and eggs in the nest, and have been known to eat young chickens and even young pheasants. The spreading adder (Heterodon contortrix) does appear to be unduly destructive to toads, at least in the eastern States. In the Middle West, this same snake has a more varied diet, for mice, grasshoppers, and other insects form a large proportion of its annual food.

Some allowance must be made for local conditions in estimating the food habits of any animal. Snakes, like other animals when hungry, will satisfy their hunger with whatever food is available. Whenever snakes are present in what appears to be abnormally large numbers, there must be an abundance of living animal food in the vicinity to attract them. Poisonous snakes have no place in a settled country, no matter how beneficial their food habits may be. Most of the nonvenemous snakes, however, should be given as much consideration as any other animal which is directly or indirectly assisting man in combating pests which threaten to devour our crops.

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UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF BIOLOGICAL SURVEY

FACTS ABOUT SNAKES*

Contents

SOME POPULAR MISCONCEPTIONS

Few native animals are more imperfectly known, more persecuted, or more misrepresented than snakes. Contrary to popular belief most of them are neither obnoxious nor poisonous. Because of false teaching many persons have a great dread of snakes, and there are very few who care to have those reptiles around their homes. Campers are often troubled with snakes that take refuge under bedding, boxes, or clothing; and nervous persons suffer severe shocks from discovering snakes in unexpected places; Constant worry, however, from fear that there will be a repetition of such unpleasant experiences can be avoided by taking necessary precautions. In most cases snakes can be prevented from entering places where they are not wanted.

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*This leaflet has been compiled from dependable sources for the information of correspondents and others. In another mimeographed leaflet (Bi-571), similarly compiled, is given reliable information regarding "Poisonous Snakes of the United States." Copies will be furnished by the Biological Survey on request.

fishy odor given off by full-grown leaves of the horse-shoe geranium (Pelargonium zonale) is also thought by some to drive away snakes. Various other plants are supposed to possess similar powers, but careful investigation has failed thus far to corroborate any potency of this sort on the part of any plants. So far as known, no North American plants will drive away snakes or cause snakes to avoid areas on which they are growing. None of the various repellents, such as cayenne pepper, fresh slaked lime, or powdered sulphur, which have been suggested from time to time, have been found to possess any particular merit.

In many parts of the West the old-time horse or cow-hair ropes, about 30 feet long, were and still are used by cowboys, ranchers, and prospectors to surround their beds when sleeping on the ground, in the belief that they would exclude snakes. Experimentation with live rattlesnakes as well as with harmless snakes has shown that no protection is afforded by a hair rope. Repeated trials have proved that a rattlesnake will crawl over a hair rope without hesitation.

SNAKE MYTHS

Since the earliest periods of time reptiles, particularly snakes, have been endowed by man with all sorts of mythical attributes and peculiarities; and a surprisingly large number of persons still cling to these ancient beliefs. The fairy tales of childhood become more vague with the passing of years, but it is no easy task to convince people that tales told about snakes are merely delusions. The superstitious fear of snakes in general has become so firmly fixed in our minds that it is almost impossible to eradicate it. Those who attempt to dispel stories about snakes sucking cows or about stinging snakes armed with an extraordinary spike-like tail, or stories dealing with hoop snakes that take their tails in their mouths and roll in pursuit of a victim with incredible velocity, are looked upon as contemptuous scoffers or else as lacking practical experience or even as mentally unbalanced.

Two of the most persistent and widespread snake myths in the United States deal with reptiles locally known as the "stinging snake" and the "hoop snake." Tales have long been told by negroes in the South of snakes that form themselves into hoops and roll in pursuit of their victims with race-horse speed, the tails of which are furnished with horns. If the victim dodged and a tree was struck by the hoop snake it was sure to die. That any snake could place its tail in its mouth and roll along like a hoop is manifestly absurd, and taking into consideration the anatomical peculiarities of the vertebral column it is clearly impossible. The "stinging snake" myth apparently originated more than 200 years ago and is reported to have been first published in an old "Report to the Lords Proprietors of the Carolinas." John Clayton also mentions this myth in a letter to the Royal Society of London in 1688. In the first-mentioned report it is asserted that there lived in the Carolinas a snake the tail of which was a poisoned horn or spike. This account refers to the horn, or stinging snake, (Farancia abacura) , which is harmless. The horn snake is bluish-black with a few red bars across the belly, and its tail tapers to a fine point having the appearance of a horn or spike, but it is quite incapable of piercing or stinging anything.

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Some snakes have been accused of sucking milk from cows. Anyone who has ever milked a cow knows that the suction required to obtain a flow of milk is much greater than could be exerted by any snake. Furthermore, a snake has two rows of sharp recurved teeth in each upper jaw. If the mouth of the "milk snake" were closed to permit suction, the teeth would sink into the teat and the snake would find itself fully occupied in efforts to avoid injury by the cow.

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The coach-whip snake (Coluber flagellum) of the South is the object of a curious superstition prevalent among the negroes and even among many of the whites. This snake has long been a terror to the colored population of the South, and many are the stories that relate to negroes found dead in the road from being whipped to death by a coach-whip snake. These stories no doubt had their origin in warnings given years ago to restrain the negro slaves from straying off at night. The coach-whip snake is a slender, swift-moving, brownish-black snake of the southern and southwestern parts of the United States, and is entirely harmless to man, but its habit of raising the fore part of the body when traveling confirmed, as far as the negro was concerned, the stories that had been told him.

GENERAL HABITS OF SNAKES

It is to be borne in mind that there are many kinds of snakes and that their habits are nearly as varied as those of birds and mammals. Some snakes burrow into the ground and are rarely seen; others are gliders and move swiftly; some are swimmers and spend most of their lives in swamps, ponds, or streams; a few climb trees. There are certain kinds that are found only in desert regions, others only in marshes, and many that live in the fields and woods around human habitations.

Most snakes are "gliders." Large transverse scales or shields are present along the entire length of the body on the ventral surface -- as many as there are pairs of ribs. In gliding, the fore part of its body is first advanced; the ventral transverse scales on this part are then partially erected, the weight of this part of the body thrown on these erected transverse scales, and a rather firm hold obtained on the surface; the rest of the body is then drawn forward by the contraction of muscles. This process is rapidly repeated, and as the ribs are active agents in this peculiar method of propulsion, snakes are sometimes referred to as "rib-walkers."

Snakes that climb are more agile than terrestrial species. Some wind their bodies around the tree; others, like blacksnakes, can climb rough-barked trees by progressing in wide sinuous curves.

In swimming, a snake depends as much upon undulating movements of the body as upon short strokes of the tail.

HIBERNATION

In temperate climates all snakes hibernate. Their chance of survival in northern latitudes depends upon their burrowing ability -- those that burrow beneath the frost line survive the cold season; the others perish. Snakes are extremely sensitive to cold, many of the common North American forms not ranging much farther north than the Canadian border, and others staying south of the Ohio River. The exceptionally wide range of the garter snake is known to extend northward to the region around Great Slave Lake, and there are records of it that appear to be authentic from the Yukon region. In relatively mild climates blacksnakes have been found hibernating in cavities in trees several feet from the ground. Rattlesnakes, copperheads, and certain other snakes have dens in rocks in which they hibernate during the coldest part of winter. At times large numbers of snakes congregate in a single cavity, where they pass the winter. References are found in literature to "bundles" of snakes found by workmen blasting in regions underlaid by a rock formation.

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SHEDDING SKINS

All vertebrates slough off the epidermis from time to time. In human beings the change is gradual and imperceptible; other mammals, as rabbits, mice, and squirrels, change their hair in spring and fall; the "molt" of birds is well known. In the case of snakes, the entire epidermis , including that covering the cornea of the eye, is sloughed off whole.

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ECONOMIC VALUE OF SNAKES

Many of our common snakes are largely beneficial and should be protected. Such snakes are not poisonous and while they may bite or attempt to when captured, their bite is usually no more than a scratch and is nonvenomous. Snakes devour large numbers of insects and mice, many of which are injurious to garden crops and stored foodstuffs.

One of the most abundant snakes in many parts of this country is the common garter, or ribbon, snake (Thamnophis). The natural food of these snakes consists of salamanders, small frogs, earthworms, insects, spiders, and an occasional mouse. When grasshoppers are plentiful they often subsist largely on them.

The blacksnake (Coluber obsoletus) and the pine snake (Pituophis melanoleucus) subsist largely on field and meadow mice, chipmunks, rats, and young rabbits, and to a less extent on birds, frogs, and insects.

The house snake, or checkered adder (Lampropeltis triangulum), lives in gardens and fields and although it is entirely harmless, there seems to be much superstitious fear of it. The name "house snake" has been given it because it enters dwellings in fall. More than half its yearly food consists of mice. It has been known also to eat other snakes.

The kingsnakes (Lampropeltis getulus) are able to kill rattlesnakes and have been known to eat them. When the early settlers found these snakes fairly common throughout the region infested by rattlesnakes and moccasins, stories soon arose of their hunts for rattlers. The kingsnake does eat other snakes, but it does not deliberately hunt for poisonous snakes.

The little red-bellied snake (Storeria occipito-maculata) subsists to a large extent on slugs, pests very destructive to garden crops. The DeKay snake, or rock snake (Storeria dekayi), has similar habits and eats slugs, snails, earthworms, and insect larvae. Insects constitute the main source of food for the smooth-scaled green snake (Liopeltis vernalis) and the rough-

scaled green snake (Opheodrys aestivus), but snails and spiders form about one-fourth of the total bulk.

The pretty little ring-necked snake (Diadophis punctatus) feeds mainly on insects and to a less extent on salamanders, small frogs, and earthworms. The rubber boa, or ball snake (Charina bottae), will eat mice and small birds. Bull snakes and gopher snakes (Pituophis) destroy large numbers of injurious rodents in the course of a year. Even rattlesnakes do some good, because ground squirrels, young prairie dogs, and other rodents are their main food.

The food habits of a few of our snakes are of such nature that they conflict with man's interests. The common water snake (Natrix sipedon) feeds largely on small fish, but in most cases its food has been found on examination to consist mainly of fishes not used as food by man, and the remainder includes toads, frogs, salamanders, insects, and small mammals. The moon snake, or queen snake (Natrix septemvittata), is known to feed largely on crawfishes and toads. The blacksnake (Coluber obsoletus) and the coach-whip snake (Coluber flagellum) destroy a certain number of ground-nesting birds, particularly young quail and eggs in the nest, and have been known to eat young chickens and even young pheasants. The spreading adder (Heterodon contortrix) does appear to be unduly destructive to toads, at least in the eastern States. In the Middle West, this same snake has a more varied diet, for mice, grasshoppers, and other insects form a large proportion of its annual food.

Some allowance must be made for local conditions in estimating the food habits of any animal. Snakes, like other animals, will satisfy their hunger with whatever food is available. Whenever snakes are present in what appear to be abnormally large numbers, there must be an abundance of living animal food in the vicinity to attract them. Poisonous snakes have no place in a settled country, no matter how beneficial their food habits may be. Most of the nonvenomous snakes, however, should be given as much consideration as any other animal that directly or indirectly assists man in combating pests that threaten to devour his crops.

PRECAUTIONARY MEASURES AGAINST SNAKES

There is little likelihood of accidents from snakes if the following suggestions are borne in mind:

Campers should avoid pitching their tents in swampy areas and in the vicinity of rocky ledges. Clean camping sites are preferable. Everyone should take the necessary precautions of observing where he walks and especially where he puts his hands. Bedding and clothing should be hung up during the day.

Hunters in southern States have found that leather leggings afford sufficient protection against the bites of poisonous snakes, and a specially constructed rubber boot, with a shank including several layers of canvas, used by quail hunters in Florida, is a perfect protection for the parts it covers.

Full information about poisonous snakes and methods of treating their bites is contained in Leaflet Bi-571, "Poisonous Snakes of the United States" (see footnote, page 1).

SUGGESTIONS FOR SNAKE-PROOFING A BUILDING

When snakes gain access to a building, the doors and windows of which are screened, there must be crevices in the walls, foundation, or floor. In such cases all openings in the floor, weather-boarding, sills, foundations, and around fireplaces and chimneys should be found and carefully closed up. If a building can be surrounded by a fairly deep vertical-sided trench with no bridges over it, snakes will be excluded, but in ordinary soils such a trench will not long retain its effectiveness. A permanent concrete moat would in most cases be considered too expensive.

The construction of tight basement walls or sealing the sides of a cellar with a layer of cement will exclude snakes. Foundations under houses and barns may be "pointed-up" with cement in the same way. If the walls under any building are sealed with cement and all low windows screened, snakes and other undesirable animals can not gain entrance. The debris that often accumulates under porches should be removed and the space kept clean.

SUGGESTIONS FOR ERADICATING UNDESIRABLE SNAKES

There are so many snakes in most neighborhoods and they frequent such inaccessible spots that their total eradication is practically impossible. So long as there are large uninhabited areas, snakes will continue to spread from these centers into settled districts, even though a constant warfare be kept up against them. The introduction of predatory animals, like the mongoose, to combat them, no matter which sex, is never desirable because they destroy at least as many ground-nesting birds as they do injurious animals. The importation of mongooses is prohibited by law.

So far as known, only one method of snake eradication is generally successful, and that is to kill by clubbing or shooting. Local campaigns for the destruction of poisonous snakes, as the cottonmouth moccasin, the copperhead, the rattlesnake, the massasauga, and the coral snake are desirable in many districts. Most of the nonpoisonous snakes are distinctly beneficial in that their food consists to a large extent of injurious rodents and insects, and all campaigns against snakes should discriminate between poisonous and nonpoisonous varieties.

USE OF POISONOUS GASES

Snakes appear to be immune from the effects of certain kinds of poison gases, as phosgene, chlorine, and tear chemicals. Tests conducted in a cave near San Marcos, Hays County, Texas, approximately 50 miles north of San Antonio, failed to produce any results when phosgene and chlorine fumes were forced under pressure into the recesses of a rocky cave infested with rattlesnakes. On the other hand, in the State of Washington, when mustard gas was forced into the crevices of a bed of lava rock, rattlesnakes were driven out in a dazed and blinded condition and were easily killed with clubs.

Field employees of the Biological Survey have had considerable success in destroying rattlesnakes with crude calcium cyanide. It has been found that two ounces of calcium-cyanide dust (about two tablespoonfuls) are required to kill a rattlesnake that has taken refuge in a ground-squirrel or prairie-dog burrow. The cyanide is placed well down into the burrows by means of a ladle or long-handled spoon and should be piled up rather than scattered. A stone or piece of sod should be used to cover the entrance in preference to soil, which might slide into the hole and interfere with the formation of the gas. Under ordinary conditions, a snake will be killed in about three minutes' exposure to the cyanide gas.

It must be remembered that calcium cyanide is a deadly poison. It should be kept in the original air-tight container and out of reach of irresponsible persons, children, and livestock. Small quantities of cyanide may be carried to the area to be treated in a can fitted with a tight top. All handling of the material should be done in the open air.

The effectiveness of any given dosage of calcium cyanide depends upon the realtive humidity, for the moisture in the air liberates hydrocyanic-acid gas, which remains active in the burrow for several hours, diffusing in all directions. Unsatisfactory results can be expected, however, when calcium cyanide is used in rainy weather. Temperature is not a limiting factor, provided the snakes are not hibernating. The quantity of calcium cyanide necessary to kill snakes in a den or cave depends upon the number of cubic feet of air space to be saturated with the poisonous gas. In general it appears that 2 ounces of cyanide will liberate a deadly concentration of gas in a space not exceeding 5 cubic feet, provided there are no leakages through crevices or other openings. Calcium cyanide is offered for sale in 1 and 5 pound cans. A list of dealers will be furnished by the Biological Survey, on request.

If snakes prove troublesome by entering houses or buildings used for workshops and storage, and the buildings are so constructed that they can be tightly closed or sealed up for a short period, fumigation by hydrocyanic-acid gas is recommended. Full instructions for using this gas are contained in a mimeographed leaflet, which may be obtained on application to the Bureau of Entomology, United States Department of Agriculture. Buildings in which hydrocyanic-acid is used must be vacated for a day or more, for this gas is extremely deadly and will destroy every living thing within the building where used.

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Facts about snakes.

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OTHER METHODS OF ERADICATION

In spring frequently whole colonies of rattlesnakes and copperheads can be destroyed by locating the rocky ledge beneath which they have wintered. Here in the early days of March and April they lie in the sun and are so sluggish that they may easily be dispatched with clubs. Later on in spring they spread out to the fields and hillsides in search of mice, small birds, and other prey. Where conditions permit, numbers of hogs, if given free run of snake-infested areas, will greatly reduce the snake population. Except by this method, control measures can not be applied against snakes on a large scale, and each reptile has to be considered individually.

No successful apparatus for snaring snakes has ever been devised. It is difficult to induce a snake to enter a trap, for it has no fixed trails and lacks inquisitiveness. Some collectors have been able to capture certain kinds of snakes by tying a small frog by one leg to a stake in suitable surroundings. The snake swallows the frog and is held captive until digestion dissolves the swallowed bait giving the trapper opportunity to return and dispose of the snake. Another method is to dig pits three or more feet deep with vertical sides and place several live frogs or mice in them for decoys. Such pits should not be used in any neighborhood where either livestock or human beings are accustomed to travel. Professional collectors depend almost entirely upon a forked stick or a pair of iron tongs, 3 or 4 feet in length, to capture snakes.

A few snakes, like the blacksnake (Coluber constrictor) and chicken snakes (Elaphe quadrivittata and Elaphe bairdi), enter poultry houses and barns in search of eggs or young birds. Snakes known to feed on eggs may sometimes be killed by poisoned eggs. The most satisfactory method of preparing the bait is to make a small hole in a fresh egg, and to introduce through it 2 or 3 medium-sized crystals of strychnine. A piece of paper should then be pasted over the hole and allowed to dry. The prevent leaking when the poisoned egg is put out for the snake, care should be taken to see that the part of the egg with the hole in it is placed highest. This remedy will prove effective only in case a snake has formed the habit of raiding hen's nests. Poisoned eggs placed at random might never be taken and within a few days they would become unattractive as bait. The promiscuous distribution of poisoned eggs would by very dangerous also, as it might cause the death of domestic animals, especially hogs. Blacksnakes and chicken snakes are not very wary and appear incapable of detecting "doctored eggs." Most of our snakes feed chiefly on living prey, and thus can not be destroyed by the use of poisoned baits.